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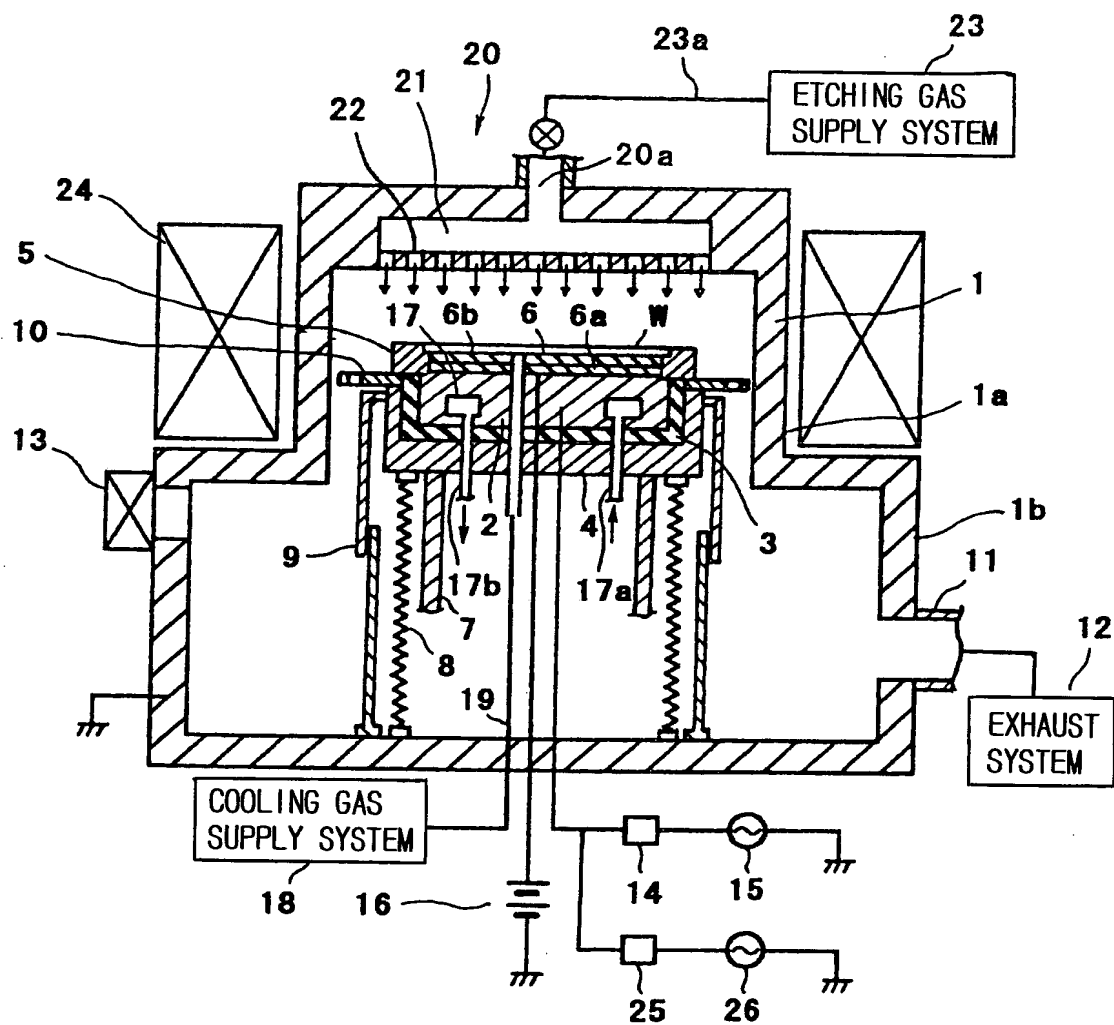


FIG. 1

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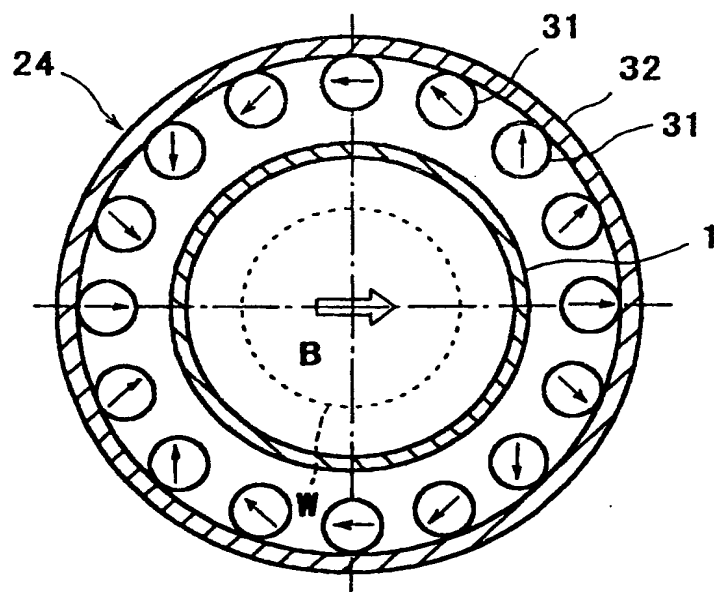


FIG. 2

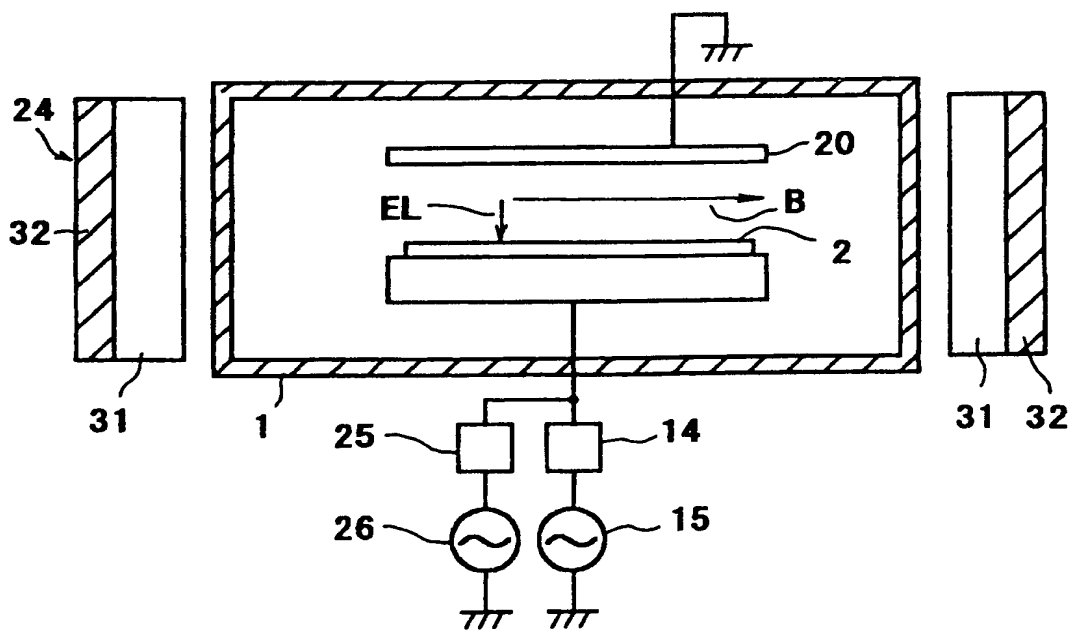


FIG. 3

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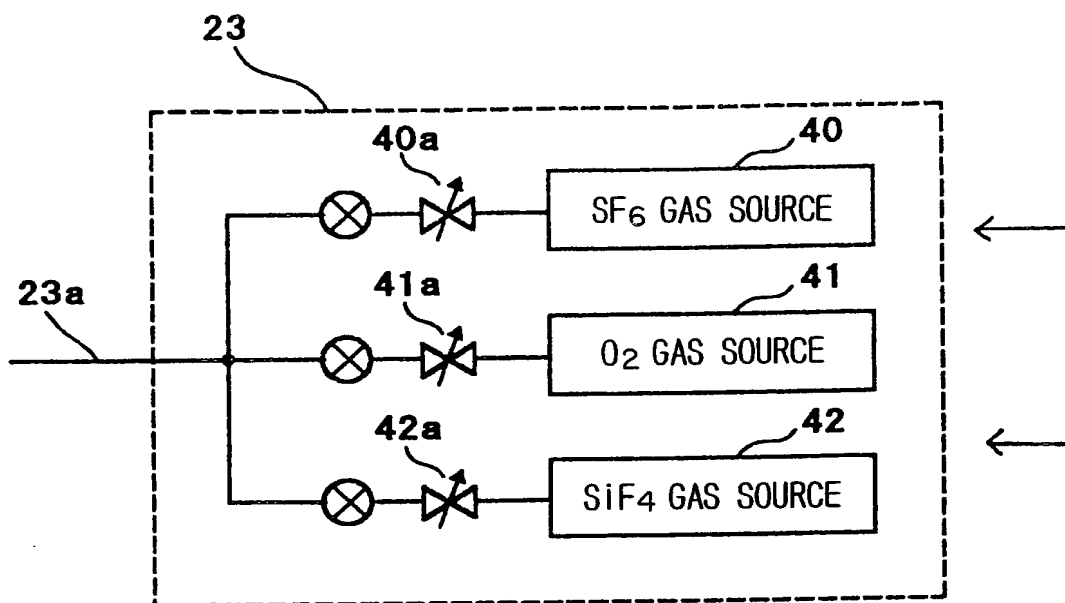


FIG. 4

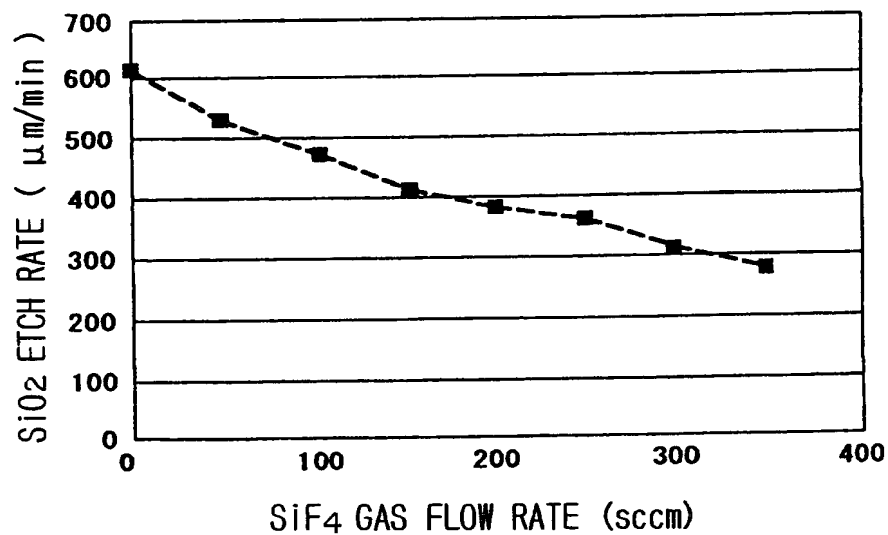


FIG. 5

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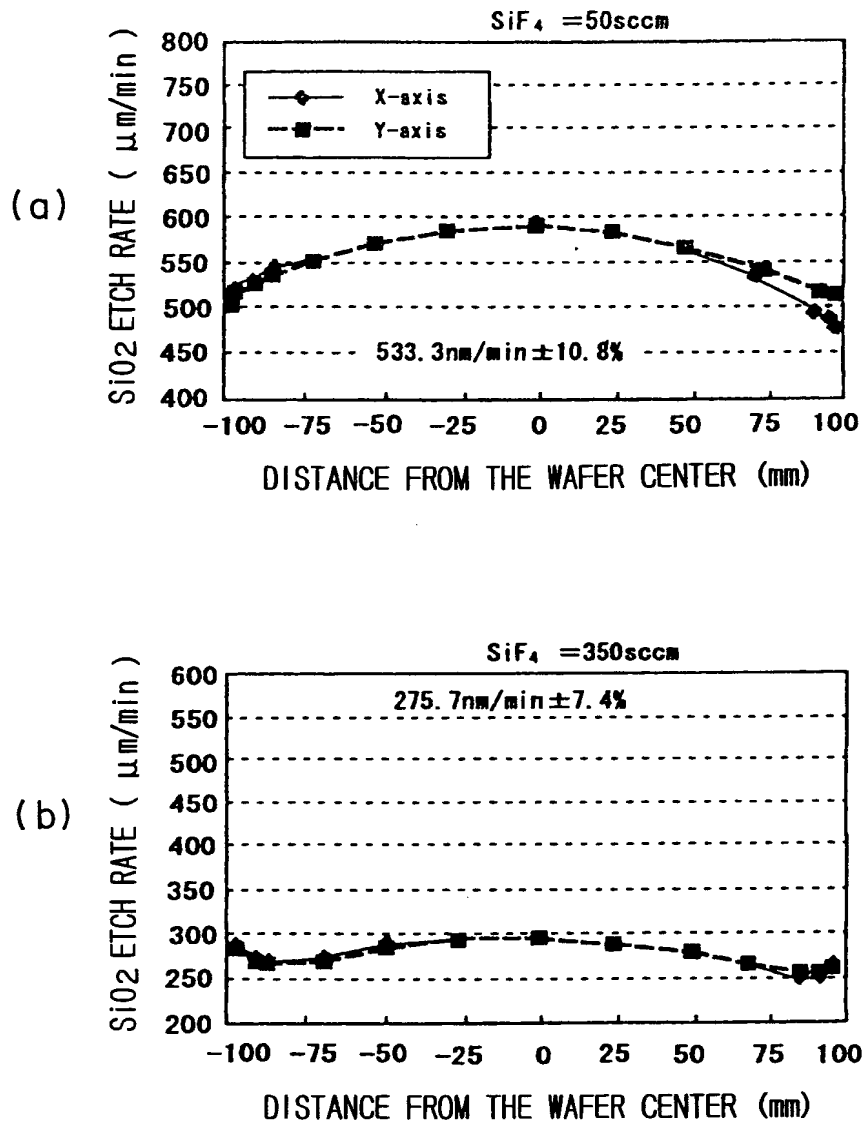


FIG. 6

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5 μ m ϕ TRENCH ETCH

	ETCHING GAS FLOW RATE (sccm)	Si E/R (μ m/min)			SiO ₂ E/R (\AA /min)			Si ETCH SELECTIVITY		UNDERCUT (μ m/min)		TAPER ANGLE (deg.)	
		CEN- TER	EDGE		CEN- TER	EDGE		CEN- TER	EDGE	CEN- TER	EDGE	CEN- TER	EDGE
COMPARATIVE EXAMPLE a1	SF ₆ /O ₂ (400/75)	19.8	19.5		6290	6498		31.4	30.0	0.42	0.20	88.99	89.02
EXAMPLE A1	SF ₆ /O ₂ /SiF ₄ (200/40/250)	14.8	14.6		4636	4899		31.9	29.8	0.23	0.19	-	-
EXAMPLE A2	SF ₆ /O ₂ /SiF ₄ (200/80/250)	15.4	15.1		3463	3847		44.4	39.2	0	0	-	-
EXAMPLE A3	SF ₆ /O ₂ /SiF ₄ (200/160/250)	15.6	15.2		3377	3737		46.1	40.7	0	0	88.74	88.31
EXAMPLE A4	SF ₆ /O ₂ /SiF ₄ (400/80/250)	17.2	16.9		5468	5192		31.5	32.6	0.37	0.33	-	-
EXAMPLE A5	SF ₆ /O ₂ /SiF ₄ (400/160/250)	17.4	17.5		4581	4708		38.0	37.1	0	0	-	-
EXAMPLE A6	SF ₆ /O ₂ /SiF ₄ (600/240/250)	17.5	17.6		5045	4920		34.7	35.7	0	0	-	-

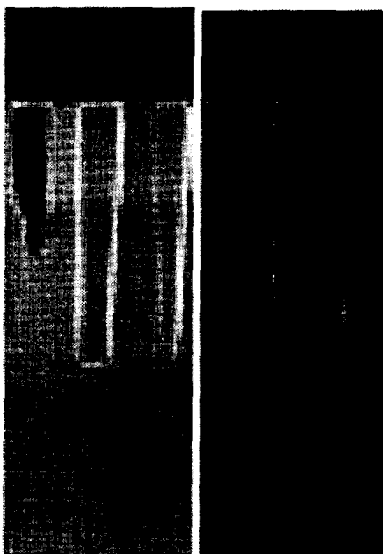
FIG. 7

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[COMPARATIVE EXAMPLE a1]

(CENTER)

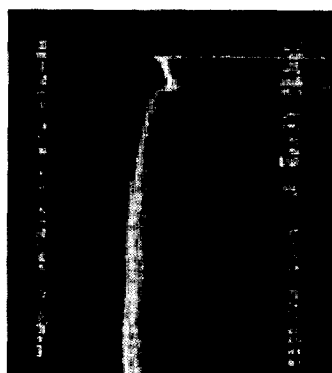
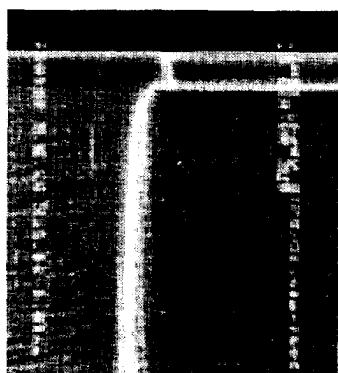
(EDGE)



ENLARGED VIEW OF A PART NEAR THE MASK

(CENTER)

(EDGE)



← SiO₂ (MASK)

← Si

FIG. 8

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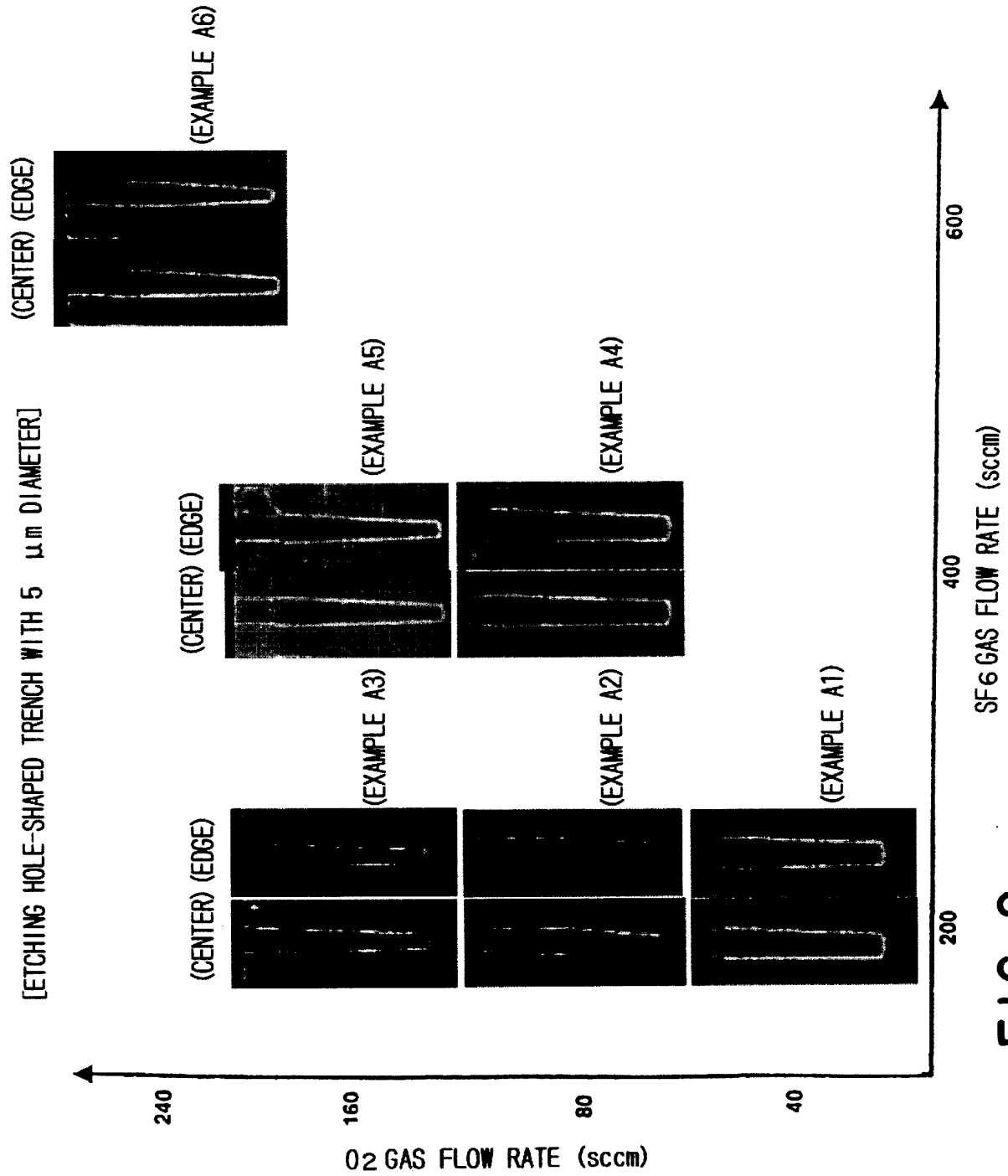


FIG. 9

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ENLARGED VIEW OF A PART NEAR THE MASK

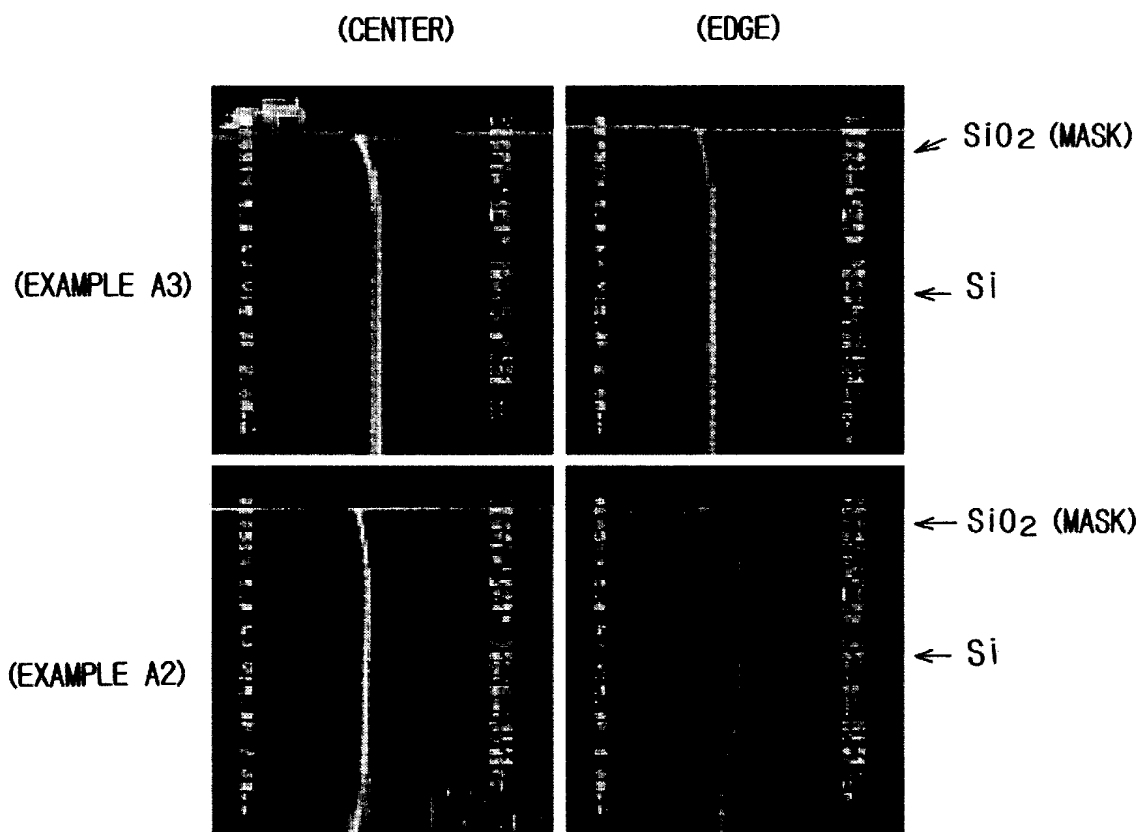
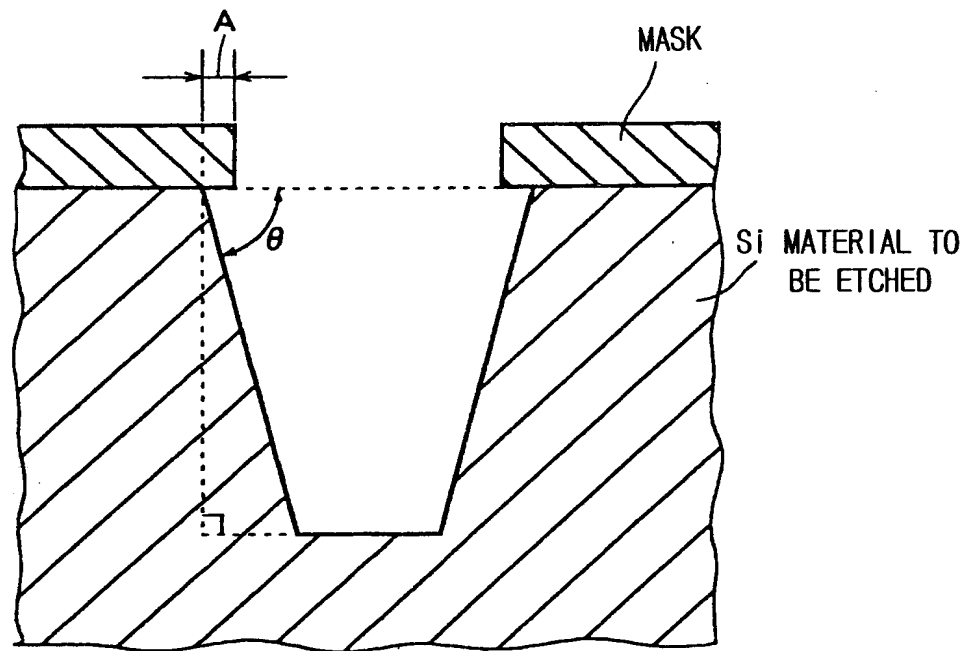


FIG. 10

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A: UNDERCUT
 θ : TAPER ANGLE

FIG. II

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20 μ m ϕ TRENCH ETCH

	ETCHING GAS FLOW RATE (sccm)	Si E/R (μ m/min)		SiO ₂ E/R (\AA /min)		Si ETCH SELECTIVITY		UNDERCUT (μ m/min)		TAPER ANGLE (deg.)	
		CEN- TER	EDGE	CEN- TER	EDGE	CEN- TER	EDGE	CEN- TER	EDGE	CEN- TER	EDGE
COMPA- RATIVE EXAMPLE b1	SF ₆ /O ₂ (400/75)	28.9	28.3	6290	6498	46.0	43.5	0.74	0.39	89.33	89.14
EXAMPLE B1	SF ₆ /O ₂ /SiF ₄ (200/40/250)	20.9	21.0	4636	4899	45.1	42.9	-	-	-	-
EXAMPLE B2	SF ₆ /O ₂ /SiF ₄ (200/80/250)	21.5	21.0	3463	3847	62.1	54.6	0	0	-	-
EXAMPLE B3	SF ₆ /O ₂ /SiF ₄ (200/160/250)	15.4	14.2	3377	3737	45.5	38.1	-	-	-	-
EXAMPLE B4	SF ₆ /O ₂ /SiF ₄ (400/80/250)	24.6	23.9	5468	5192	45.1	46.0	-	-	-	-
EXAMPLE B5	SF ₆ /O ₂ /SiF ₄ (400/160/250)	23.2	23.3	4581	4708	50.6	49.5	-	-	-	-
EXAMPLE B6	SF ₆ /O ₂ /SiF ₄ (600/240/250)	22.8	22.7	5045	4920	45.2	46.2	-	-	-	-

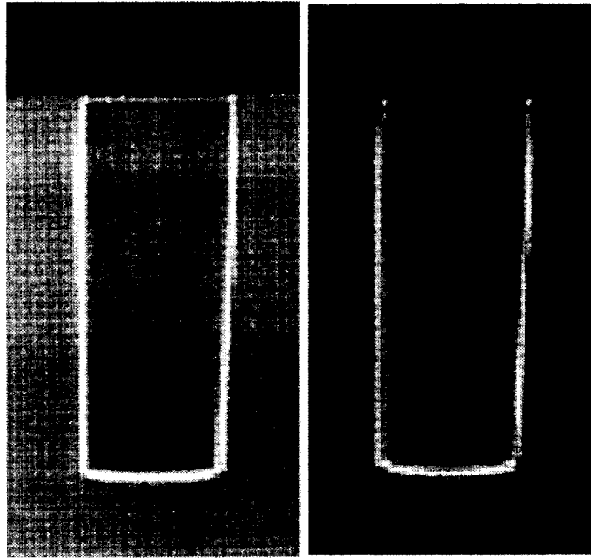
FIG. 12

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[COMPARATIVE EXAMPLE b1]

(CENTER)

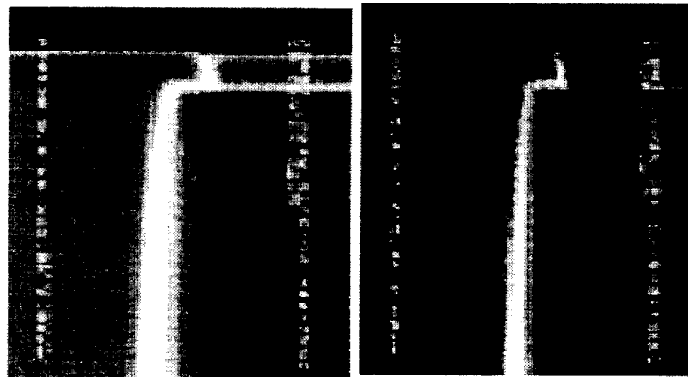
(EDGE)



ENLARGED VIEW OF A PART NEAR THE MASK

(CENTER)

(EDGE)



← SiO₂ (MASK)

← Si

FIG. 13

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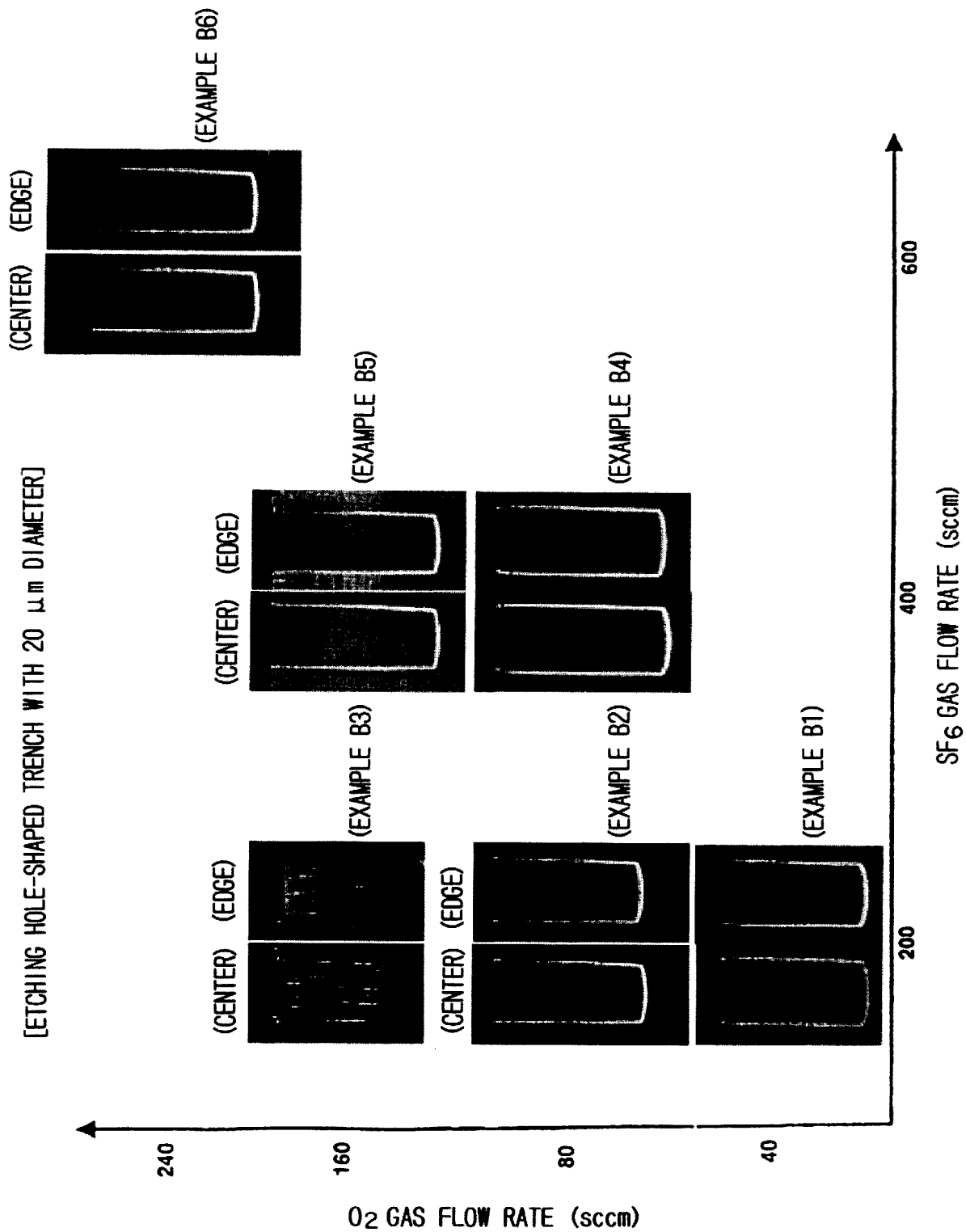


FIG. 14

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ENLARGED VIEW OF A PART NEAR THE MASK

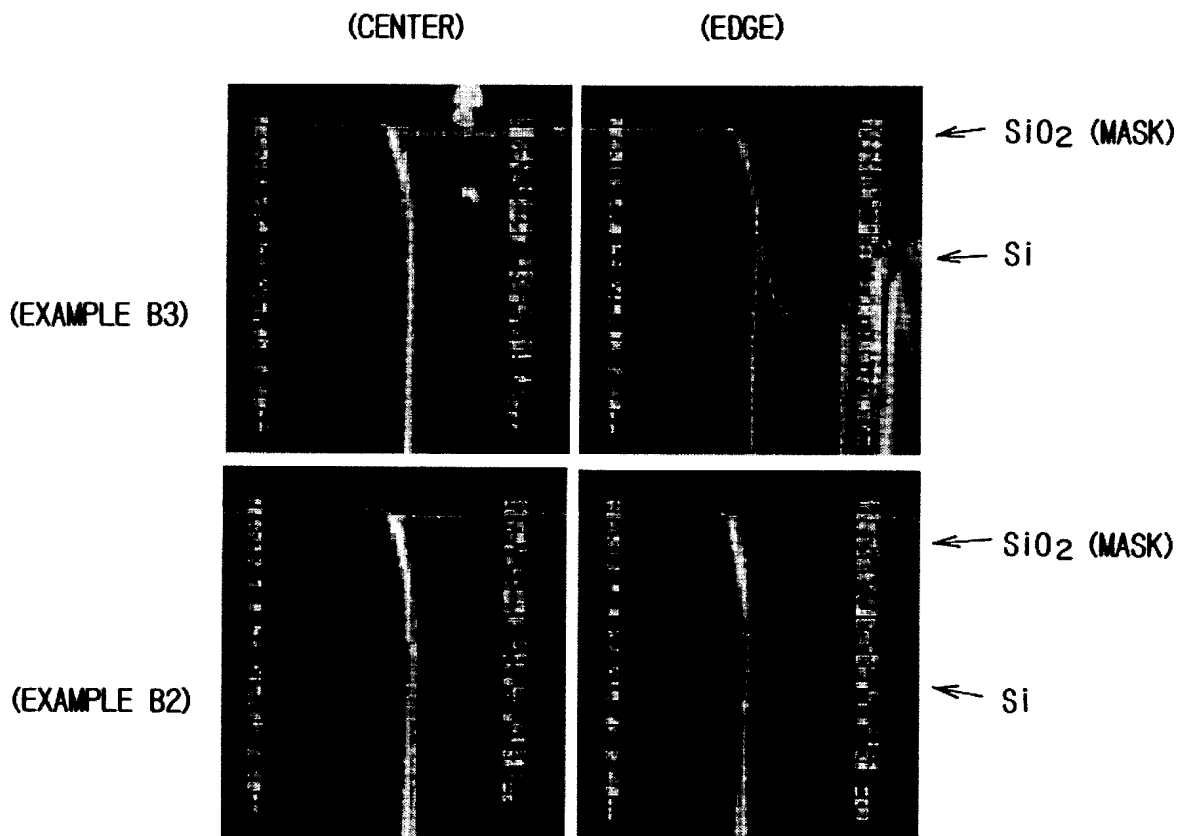


FIG. 15

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5 μ m ϕ TRENCH ETCH

	RF POWER (W)	PRES- SURE (mTorr)	Si E/R (μ m/min)		SiO ₂ E/R (\AA /min)		Si ETCH SELECTIVITY		TAPER ANGLE (deg.)	
			CEN- TER	EDGE	CEN- TER	EDGE	CEN- TER	EDGE	CEN- TER	EDGE
EXAMPLE C1	1200	250	15.6	15.2	3377	3737	46.1	40.7	88.74	88.31
EXAMPLE C2	1700	250	16.1	16.0	3663	4308	44.1	37.0	90.00	89.80
EXAMPLE C3	2200	250	15.7	16.3	3513	3850	44.6	42.4	91.09	-
EXAMPLE C4	2200	450	21.0	21.2	3717	4848	56.6	43.8	89.09	88.70

FIG. 16

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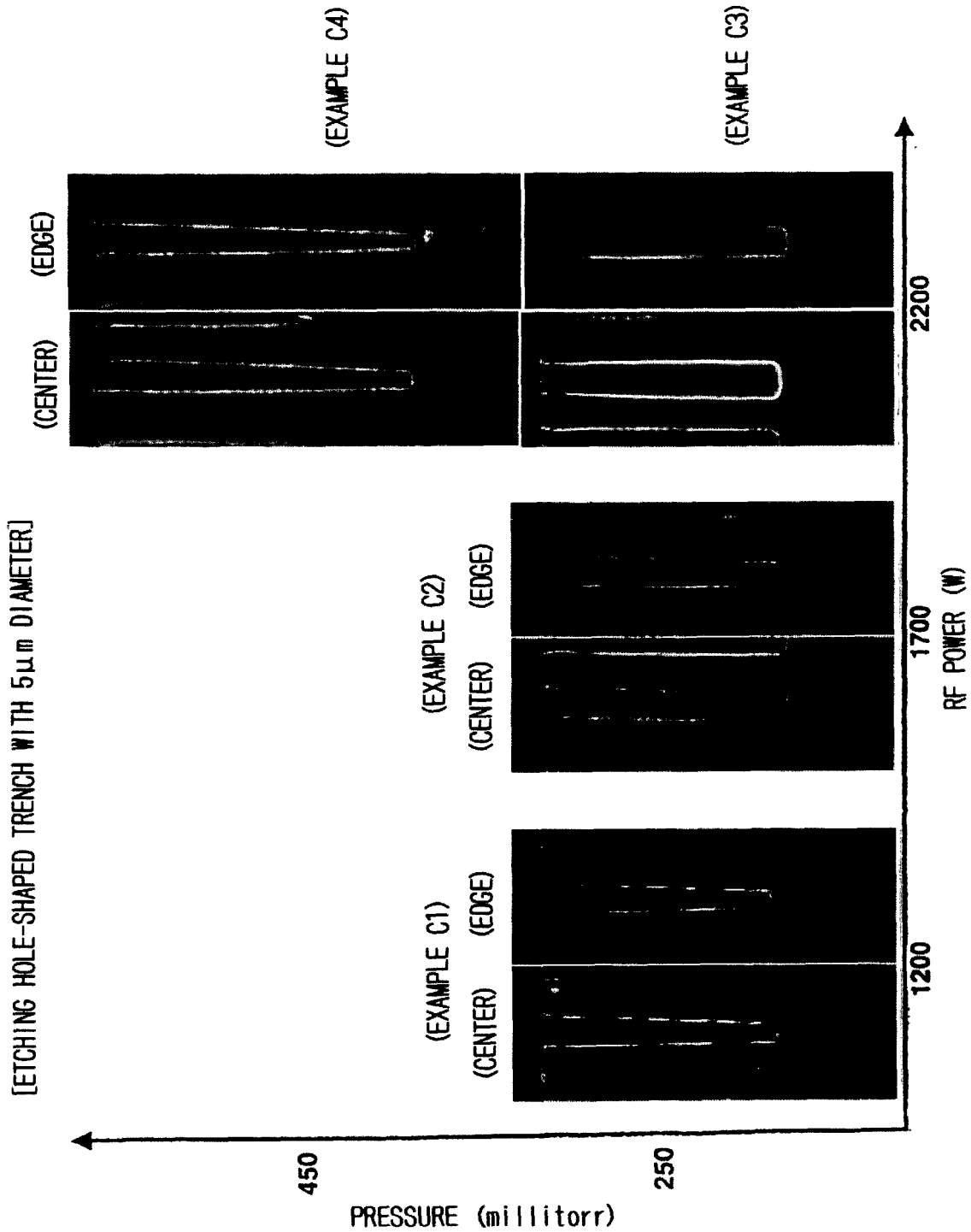


FIG. 17

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20 μ m ϕ TRENCH ETCH

	RF POWER (W)	PRES- SURE (mTorr)	Si E/R (μ m/min)		SiO ₂ E/R (\AA /min)		Si ETCH SELECTIVITY	
			CEN- TER	EDGE	CEN- TER	EDGE	CEN- TER	EDGE
EXAMPLE D1	1200	250	15.4	14.2	3377	3737	45.5	38.1
EXAMPLE D2	1700	250	18.7	17.2	3663	4308	51.1	39.9
EXAMPLE D3	2200	250	20.4	17.9	3513	3850	58.1	46.4
EXAMPLE D4	2200	450	28.6	26.3	3717	4848	76.9	54.2

FIG. 18

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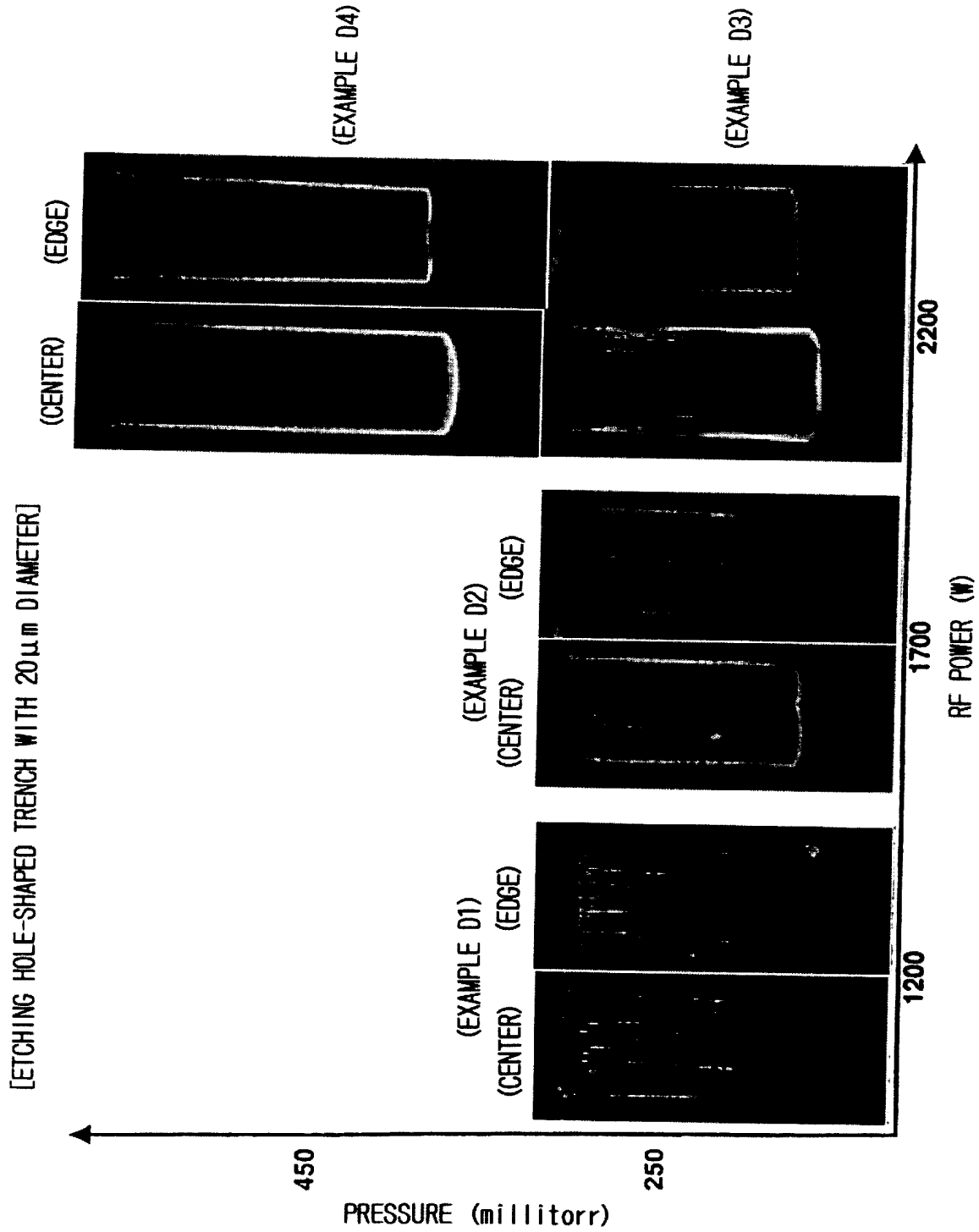


FIG. 19

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3 μ m ϕ TRENCH ETCH WITH RESIST MASK

	RF POWER (w)	PRES- SURE (mTorr)	O ₂ FLOW RATE (sccm)	SiE/R (μ m/min)		RESIST E/R (\AA /min)		Si ETCH SELEC- TIVITY		NOTE
				CEN- TER	EDGE	CEN- TER	EDGE	CEN- TER	EDGE	
EXAMPLE F1	450	130	120	6.5	6.6	4118	3016	15.7	21.8	STEPS ARE FORMED ON SIDEWALLS OF TRENCHES
EXAMPLE F2	700	230	120	10.33	10.71	6348	5475	16.3	19.6	
EXAMPLE F3	1000	350	120	12.48	13.08	8796	8538	14.2	15.3	SLIGHTLY INVERSELY TAPERED
EXAMPLE F4	1000	350	180	15.72	16.02	8963	9144	17.5	17.5	SLIGHTLY BOWING

FIG. 20

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1.2μm-WIDTH TRENCH ETCH

	ETCHING GAS FLOW RATE (sccm)	PRES- SURE (mTorr)	RF POWER (W)	BACK PRESSURE (Torr)		TIME (sec)	LOCA- TION	TRENCH LENGTH	Si ETCH SELEC- TIVITY (Si/SiO2)	Si E/R (μm/ min)	TAPER ANGLE (deg)
				CEN- TER	EDGE						
COMPA- RATIVE EXAMPLE 1	SF6/O2 (150/90)	70	650	7	40	60	CEN- TER	1μm	21.2	5.72	88.3
								2μm	22.4	6.05	
								10μm	24.2	6.54	87.7
							EDGE	1μm	31.9	6.30	87.3
								2μm	35.0	6.91	
								10μm	37.0	7.30	86.9
COMPA- RATIVE EXAMPLE e2	SF6/O2 (150/90)	100	650	10	40	60	CEN- TER	1μm	21.3	6.28	87.5
								2μm	24.4	7.19	
								10μm	24.7	7.27	86.8
							EDGE	1μm	32.0	5.76	86.7
								2μm	36.7	6.60	
								10μm	36.8	6.62	86.4
COMPA- RATIVE EXAMPLE e3	SF6/O2 (150/90)	70	500	15	40	60	CEN- TER	1μm	21.0	4.84	86.5
								2μm	24.4	5.62	
								10μm	24.8	5.71	85.9
							EDGE	1μm	35.5	4.61	87.0
								2μm	40.8	5.30	
								10μm	41.1	5.34	85.7

FIG. 21

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1.2 μ m-WIDTH TRENCH ETCH

	ETCHING GAS FLOW RATE (sccm)	PRES- SURE (mTorr)	RF POWER (W)	BACK PRESSURE (Torr)		TIME (sec)	LOCA- TION	TRENCH LENGTH	Si ETCH SELEC- TIVITY (Si/SiO ₂)	Si E/R (μ m/ min)	TAPER ANGLE (deg)
				CEN- TER	EDGE						
EXAMPLE E1	SF ₆ /O ₂ / SiF ₄ (150/90 /50)	70	650	15	40	60	CEN- TER	1 μ m	20.5	5.38	87.7
								2 μ m	22.9	6.01	
								10 μ m	24.4	6.40	87.7
							EDGE	1 μ m	31.9	6.14	87.8
								2 μ m	34.3	6.59	
								10 μ m	36.3	6.97	87.6
EXAMPLE E2	SF ₆ /O ₂ / SiF ₄ (150/90 /50)	170	1400	15	40	30	CEN- TER	1 μ m	23.4	10.69	87.1
								2 μ m	25.3	11.56	
								10 μ m	26.3	12.04	86.9
							EDGE	1 μ m	30.7	11.70	87.3
								2 μ m	33.0	12.61	
								10 μ m	34.5	13.17	87.1
EXAMPLE E3	SF ₆ /O ₂ / SiF ₄ (150/90 /50)	250	2000	15	40	30	CEN- TER	1 μ m	23.1	13.05	87.3
								2 μ m	25.6	14.44	
								10 μ m	26.8	15.13	87.1
							EDGE	1 μ m	26.4	14.36	87.8
								2 μ m	28.9	15.71	
								10 μ m	31.2	16.94	87.8

FIG. 22

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1.2 μ m-WIDTH TRENCH ETCH

	ETCHING GAS FLOW RATE (sccm)	PRES- SURE (mTorr)	RF POWER (W)	BACK PRESSURE (Torr)		TIME (sec)	LOCA- TION	TRENCH LENGTH	Si ETCH SELEC- TIVITY (Si/SiO ₂)	Si E/R (μ m/mi n)	TAPER ANGLE (deg.)
				CEN- TER	EDGE						
EXAMPLE E4	SF ₆ /O ₂ / SiF ₄ (150/90/ 350)	170	1400	15	40	30	CENTER	1 μ m	52.9	9.25	88.7
								2 μ m	56.8	9.95	
								10 μ m	62.1	10.88	88.8
							EDGE	1 μ m	57.7	10.00	88.6
								2 μ m	62.6	10.86	
								10 μ m	67.5	11.69	89.0
EXAMPLE E5	SF ₆ /O ₂ / SiF ₄ (150/90/ 350)	170	1400	15	40	80	CENTER	1 μ m	37.9	7.39	88.7
								2 μ m	43.8	8.54	
								10 μ m	47.0	9.16	88.4
							EDGE	1 μ m	43.2	7.68	88.6
								2 μ m	50.7	9.02	
								10 μ m	54.8	9.75	88.5

FIG. 23